Florida Power & Light Company, 6501 S. Ocean Drive, Jensen Beach, FL 34957

April 8, 2005

L-2005-076
10 CFR 50.4

U. S. Nuclear Regulatory Commission
Attn: Document Control Desk
Washington, DC 20555

RE: St. Lucie Unit 2
Docket No. 50-389
NRC Order EA-03-009 – Reactor Vessel Head and
Vessel Head Penetration Nozzle Inspection Results SL2-15

In January 2005, St. Lucie Unit 2 commenced refueling outage SL2-15. Three reactor pressure vessel (RPV) head nozzles were repaired using an approved repair method that relocated the pressure boundary weld between the RPV head nozzle and the RPV head to the mid-thickness of the RPV head. This repair method either removed the flaw indication or detached it from the new pressure boundary weld and nozzle. Based on the results of the visual examinations, non visual examinations (UT and PT), leak path assessments (including eddy current of the vent), and inspection of the completed repairs, Florida Power & Light Company (FPL) concludes that the RPV head penetration nozzles that were returned to service were not degraded, and no wastage has occurred on the RPV head. The plant returned to operation on February 15, 2005.

In accordance with Section IV.E of the NRC Order (EA-03-009), the attachment submits the FPL inspection results for St. Lucie Unit 2 for the January 2005 refueling outage (SL2-15). With this letter, FPL has complied with the requirements of the NRC Order for the St. Lucie Unit 2 January 2005 refueling outage (SL2-15).

Please contact George Madden at 772-467-7155 if there are any questions about this submittal.

Very truly yours,

William Jefferson, Jr.
Vice President
St. Lucie Plant

WJ/GRM

Attachment

A104

NRC Order EA-03-009: Reactor Pressure Vessel Head and Vessel Head Penetration Nozzle Post Outage SL2-15 Inspection Results

The First Revised NRC Order EA-03-009[1] was issued on February 20, 2004, establishing interim inspection requirements for reactor pressure vessel heads of pressurized water reactors. In Section IV.E. of the NRC Order, the NRC required that the results of the inspection be provided within 60 days of the plant being returned to operation. Florida Power & Light Company (FPL) hereby submits the inspection results for St. Lucie Unit 2 (PSL-2) for the January/February 2005 (SL2-15) refueling outage (RFO).

St. Lucie Unit 2 January/February 2005 (SL2-15) Post Outage Reactor Vessel Upper Head Inspection Results:

1. Plant Susceptibility Category:

The St. Lucie Unit 2 reactor pressure vessel (RPV) closure head had approximately 15.4 effective degradation years (EDY) at the start of the January 2005 refueling outage. The inspection category identified in the Order is High. The corresponding inspection method specified in Section IV.C.(1). is as follows:

IV.C.(1) For those plants in the High category, RPV head and head penetration nozzle inspections shall be performed using the techniques of paragraph IV.C.(5)(a) and paragraph IV.C.(5)(b) every refueling outage.

> *5(a) Bare metal visual examination of 100 percent of the RPV head surface (including 360° around each RPV head penetration nozzle). For RPV heads with the surface obscured by support structure interferences which are located at RPV head elevations downslope from the outermost RPV head penetration, a bare metal visual inspection of no less than 95 percent of the RPV head surface may be performed provided that the examination shall include those areas of the RPV head upslope and downslope from the support structure interference to identify any evidence of boron or corrosive product. Should any evidence of boron or corrosive product be identified, the licensee shall examine the RPV head surface under the support structure to ensure that the RPV head is not degraded.*
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> *5 (b) For each penetration, perform a non visual NDE in accordance with either (i), (ii) or (iii):*
>
> *(i) Ultrasonic testing of the RPV head penetration nozzle volume (i.e.,nozzle base material) from 2 inches above the highest point of the root of the*

1 US NRC Letter EA-09-009, Issuance of First Revised NRC Order (EA-03-009) Establishing Interim Inspection Requirements for Reactor Pressure Vessel Heads at Pressurized Water Reactors, from R. William Borchardt (NRC) to all Pressurized Water Reactor Licensees, dated February 20, 2004.

J-groove weld (on a horizontal plane perpendicular to the nozzle axis) to 2 inches below the lowest point at the toe of the J-groove weld on a horizontal plane perpendicular to the nozzle axis (or the bottom of the nozzle if less than 2 inches [see Figure IV-1]);
OR from 2 inches above the highest point of the root of the J-groove weld (on a horizontal plane perpendicular to the nozzle axis) to 1.0-inch below the lowest point at the toe of the J-groove weld (on a horizontal plane perpendicular to the nozzle axis) and including all RPV head penetration nozzle surfaces below the J-groove weld that have an operating stress level (including all residual and normal operation stresses) of 20 ksi tension and greater (see Figure IV-2). In addition, an assessment shall be made to determine if leakage has occurred into the annulus between the RPV head penetration nozzle and the RPV head low-alloy steel.

(ii)Eddy current testing or dye penetrant testing of the entire wetted surface of the J-groove weld and the wetted surface of the RPV head penetration nozzle base material from at least 2 inches above the highest point of the root of the J-groove weld (on a horizontal plane perpendicular to the nozzle axis) to 2 inches below the lowest point at the toe of the J-groove weld on a horizontal plane perpendicular to the nozzle axis (or the bottom of the nozzle if less than 2 inches [see Figure IV-3]); OR from 2 inches above the highest point of the root of the J-groove weld (on a horizontal plane perpendicular to the nozzle axis) to 1.0-inch below the lowest point at the toe of the J-groove weld (on a horizontal plane perpendicular to the nozzle axis) and including all RPV head penetration nozzle surfaces below the J-groove weld that have an operating stress level (including all residual and normal operation stresses) of 20 ksi tension and greater (see Figure IV-4).

(iii) A combination of (i) and (ii) to cover equivalent volumes, surfaces and leak paths of the RPV head penetration nozzle base material and J-groove weld as described in (i) and (ii). Substitution of a portion of a volumetric exam on a nozzle with a surface examination may be performed with the following requirements:

1. On nozzle material below the J-groove weld, both the outside diameter and inside diameter surfaces of the nozzle must be examined.
2. On nozzle material above the J-groove weld, surface examination of the inside diameter surface of the nozzle is permitted provided a surface examination of the J-groove weld is also performed.

2. Inspection Scope and Method:

2.a. RPV Bare Metal Head Surface Visual: A bare metal visual inspection (VT) of the RPV head top surface, including 360° around each RPV head penetration nozzle, was performed in accordance with Section IV.C.(5)(a) of the NRC Order as supplemented by

a relaxation request submitted by FPL letter L-2004-095[2] and approved by the NRC on December 27, 2004[3] and January 10, 2005.[4] The VT was performed under the insulation by delivering a video probe through 2½-inch diameter holes in the support shroud and under the shroud support ring after removal of flashing panels. Limitations to the bare metal visual inspection were identified in the relaxation request L-2004-095. These limitations included a partial area under 32 insulation support feet (<118 square inches) and the inaccessible areas under the ~2¼-inch wide vertical leg of the reflective metal insulation that contacts the twelve 6-inch wide shroud lugs. In addition, the areas inside the 54 RV stud holes were limited. The total area of limitation is less than 1% of the total reactor vessel head surface area available for inspection.

2.b. RPV Head Penetration Inspection: The ultrasonic (UT) examination technique option, identified in Section IV.C.(5)(b)(i) of the First Revised NRC Order, was performed on all of the 102 reactor vessel head penetration (RVHP) nozzles, including the vent line. The examination area was planned to meet the NRC Order required area for the ICI, vent and previously repaired CEDM penetrations. For the 89 CEDMs with the original threaded guide cone configuration, the inspection was planned to include the nozzle base material 2 inches above the J-groove weld to the bottom of the weld. However, below the weld the UT examination was planned to the maximum extent possible. If the area below the weld coverage was less than 0.50 inches, non visual NDE from the outside diameter (OD) was used to extend the coverage to the maximum extent possible, but not less than 0.50 inches below the weld toe. The methods used for the OD NDE were automated UT and manual PT. The limitations associated with the threaded guide funnels in 89 of the original CEDM penetrations were the subject of a relaxation request L-2004-095 and corresponding NRC approvals of the relaxation dated December 27, 2004, and January 10, 2005.

As part of the UT examinations, the 101 RVHPs with interference fits were assessed to determine if leakage had occurred into the interference fit zone (annulus between the RPV head and the penetration above the pressure boundary weld). This assessment used the Framatome-ANP proprietary "leak path" technique, which was described in the post outage inspection report for the previous FPL St. Lucie Unit 1 RPV head inspection submitted by FPL letter L-2002-233.[5]

The UT inspection procedure and essential variables used on the 101 RVHPs with interference fits has been demonstrated as part of the industry demonstration program

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2 FPL letter L-2004-095, St. Lucie Unit 2, Order (EA-03-009) Relaxation Requests 3 and 4, Examination Coverage of Reactor Pressure Vessel Head Penetration Nozzles, W. Jefferson to NRC, May 6, 2004.
3 US NRC Letter, St. Lucie Plant, Unit 2, First Revised Order EA-03-009 Relaxation Request No. 3 Regarding Examination Coverage of Reactor Pressure Vessel Head Penetration Nozzles, and Relaxation Request No. 4 Regarding Examination Coverage of Reactor Pressure Vessel Head Bare Metal Visual Examination, E. M. Hackett (NRC) to J.A. Stall, December 27, 2004.
4 US NRC Letter, St. Lucie Plant, Unit 2, Correction to NRC Safety Evaluation for First Revised Order EA-03-009 Relaxation Request No. 3 Regarding Examination Coverage of Reactor Pressure Vessel Head Penetration Nozzles, E. M. Hackett (NRC) to J.A. Stall, January 10, 2005.
5 FPL letter L-2002-233, St. Lucie Units 1 and 2, Reactor Pressure Vessel Head (RPVH) Inspection, NRC Bulletin 2002-02 Supplemental Response, D. E. Jernigan to NRC, November 21, 2002.

conducted by the EPRI NDE Center. The personnel qualification requirements that were described in L-2002-233 remain unchanged.

An eddy current examination (ECT) was performed on the vent nozzle weld surface to ensure weld integrity in lieu of the UT method to assess if leakage has occurred into the clearance fit annulus between the vent nozzle and RPV head steel. The ECT procedure had been successfully demonstrated on RVHP J-groove attachment welds as part of the industry demonstration program conducted by the EPRI NDE Center. All essential variables (Examination Technique Specification sheets, ETSS) and procedural requirements used during the vent nozzle weld examination remained essentially the same as those previously demonstrated.

3. Inspection Results Summary:

3.a. RPV Head Visual Results: The overall condition of the St. Lucie Unit 2 RPV head surface was clean with no evidence of leakage occurring from the RV head to penetration interface of the 102 RVHPs. No wastage or boric acid buildup was observed on the reactor vessel head surface.

Some thin film boric acid stains were observed on and adjacent to the shroud lugs above stud holes 3, 18, 21, and 26. Staining was also identified on the vertical surfaces of two penetrations (#64 and #75) and the insulation overhead of the penetration. The thin film nature of the stains and lack of buildup is indicative of non operational leakage. The source of the stains was attributed to CEDM venting and past in-core instrument (ICI) column leakage. There was no degradation of the RPV head surface associated with the boric acid stains. These conditions were addressed as part of our boric acid corrosion control program and the corrective action program.

3.b. RPV Head Penetration Non Visual Inspection Results: Three penetrations (#27, #32, and #56) were identified with relevant indications. Penetrations #32 and #56 had axial UT indications in the non pressure boundary portion of the penetration just below the weld. Penetration #27 had a weak axial UT indication also in the non pressure boundary portion of the penetration just below the weld. A supplemental PT was performed on penetration #27 in the area of the UT indication on the base metal, overlapping the weld, and was PT white. An unrelated linear PT indication was identified in the pressure boundary weld approximately 30° away from the UT indication. The PT indication was oriented along the weld fusion line closer to the vessel shell side of the weld. The UT indication in penetration #27 was reclassified as non relevant, but the penetration was repaired as a result of the weld PT indication. The details of the non visual NDE indications in penetrations (#27, #32, and #56) are shown in the table below.

Pen #	Indication Orientation and Location	Length	Depth (inches)	Upper extent of Flaw from Weld Toe	Supplemental PT Results	Disposition of Indications or Repair
27	OD-Axial-354°	0.36"	0.107	>0.0" below	UT indication PT white.	UT reclassified - Non Relevant Indication
	PT Linear on the shell side of J-weld -25-30°	7/32"	NA	In "J" groove weld closest to shell clad	PT indication in weld	Repair – IDTB
32	OD-Axial-16° OD-Axial-256°	0.35" 0.30"	0.111 0.106	0.03" below 1.3" below	None	Repair - IDTB
56	OD-Axial-14°	0.35"	0.143	>0.0" below	None	Repair - IDTB

As identified in the bare metal visual results, there was no evidence of leakage identified at any penetration including the three with indications in the table above. There were no relevant indications identified by the ID UT in any of the other 99 RVHPs in the St. Lucie Unit 2 RPV head.

Supplemental OD NDE was required on 17 CEDM nozzles to obtain the required examination area below the weld. The OD NDE method included UT and manual dye penetrant (PT). A limitation was experienced on 14 CEDM nozzles, where the OD UT was utilized to extend the coverage below the weld toe. These limitations were caused by lift off at the funnel plug weld on the high hillside of the nozzle. The small lift off limitations were ≥3.80 inches below the weld toe and are described in the attached coverage assessment table. This supplemental OD NDE did not reveal any relevant indications.

There was also no evidence of a "leak path" signature for any of the 101 interference fit RVHPs examined. The "leak path" method is the Areva/Framatome-ANP assessment to determine if leakage has occurred into the interference fit zone. Since the vent line is a clearance fit nozzle, the clean visual inspection provides a direct determination that no leakage has occurred into the annulus. However, as an added conservatism, the flush pressure boundary surface inside of the RPV head associated with the vent line (the head vent line, Alloy 600 attachment weld, and a portion of the adjacent stainless steel clad weld) was examined using a surface eddy current examination (ECT) method. The reporting criteria utilized for the ECT examination was to report all indications. The acceptance criteria utilized for this ECT examination was "no identified flaws or degradation." There were no flaws or degradation detected by the ECT technique in the inspected area of the weld associated with the head vent nozzle. This examination provides additional confirmation for the assessment that the vent nozzle has no leakage into the annulus.

4. Corrective Actions:

Penetrations #27, #32, and #56 were repaired by removing the lower portion of the existing nozzle and detaching it from the original pressure boundary weld containing the flaw indication, and relocating the pressure boundary weld between the RVHP and the RPV head to the mid-thickness of the RPV head. The ambient temper bead weld repair process, repair configuration and post repair inspection are identified in Relief Requests 6 and 7 submitted by FPL letter L-2004-148.[6] These relief requests were approved by NRC letter dated January 21, 2005.[7]

5. Conclusion:

FPL has met the requirements of the First Revised NRC Order (EA-03-009) as modified by NRC approved relaxation requests dated December 27, 2004 and January 10, 2005 for the St. Lucie Unit 2 January/February 2005 refueling outage (SL2-15) by performing the required RPV head inspection.

Based on the results of the visual examinations, UT examinations, supplemental OD NDE, leak path assessments (including ECT of the vent), and completion of repairs to penetrations #27, #32, and #56, FPL concludes that the Alloy 600 RVHP nozzles are not degraded, and no wastage has occurred of the RPV head.

6 FPL letter L-2004-148, St. Lucie Unit 2, Inservice Inspection Plan, Unit 2 Third Ten-Year Interval, Relief Requests 6 and 7, W. Jefferson to NRC, July 21, 2004.
7 US NRC Letter, St. Lucie Nuclear Plant, Unit 2, Relief Request Nos. 6 and 7 Regarding Reactor Vessel Head Penetration Weld Repair and Flaw Evaluation for the Third 10-Year Inservice Inspection Interval, (Safety Evaluation enclosed), Michael L. Marshall (NRC) to J.A. Stall, January 21, 2005.

Table 1: SL2-15 Coverage Assessment for RPV Nozzles Examined with Coverage Limitations

		ID UT COVERAGE					OD UT COVERAGE			OD UT EXCLUSION ZONE (See Figure 1)				
Nozzle #	Required Coverage Below Weld	"A" ID Coverage below weld on downhill side of weld	ID Coverage shortage below weld on downhill side of weld	"B" ID Coverage below weld on uphill side of weld	"C" ID Coverage above weld on uphill side of weld	Circ. ID Coverage	"D" OD Coverage height from end of nozzle	ID/OD Axial Coverage Overlap	ID/OD Axial Coverage Gap	Coverage Impacted ?	Funnel plug weld exclusion zone (deg.)			Axial extent of weld plug exclusion in 1/2" band
	(in.)	(in.)	(in.)	(in.)	(in.)	(deg.)	(in.)	(in.)	(in.)		Min	Max	Total	(in.)
54	0.5	0.43	0.07	3.91	3.90	360	Examined with OD PT			No				
59	0.5	0.32	0.18	3.80	3.90	360	1.10	0.225	None	Yes	165	204	39	0.18
66	0.5	0.44	0.06	4.08	4.30	360	1.10	0.225	None	Yes	154	210	56	0.06
70	0.5	0.43	0.07	4.68	4.55	360	1.25	0.375	None	Yes	153	212	59	0.07
75	0.5	0.43	0.07	4.26	2.80	360	1.20	0.325	None	Yes	154	210	56	0.07
77	0.5	0.43	0.07	4.97	3.98	360	1.10	0.225	None	Yes	147	203	56	0.07
79	0.5	0.43	0.07	4.68	3.60	360	1.10	0.225	None	Yes	132	193	61	0.07
80	0.5	0.44	0.06	4.80	4.15	360	1.10	0.225	None	Yes	168	217	49	0.06
81	0.5	0.48	0.02	4.62	4.00	360	1.40	0.525	None	Yes	141	200	59	0.02
83	0.5	0.43	0.07	4.91	3.08	360	1.20	0.325	None	Yes	145	203	58	0.07
85	0.5	0.45	0.05	4.97	3.48	360	Examined with OD PT			No				
86	0.5	0.40	0.10	4.86	3.89	360	1.10	0.225	None	Yes	143	195	52	0.10
87	0.5	0.34	0.16	4.91	2.87	360	1.00	0.125	None	Yes	150	201	51	0.16
88	0.5	0.32	0.18	5.80	2.87	360	1.10	0.225	None	Yes	136	197	61	0.18
89	0.5	0.20	0.30	5.62	3.10	360	Examined with OD PT			No				
90	0.5	0.49	0.01	6.33	2.67	360	1.20	0.325	None	Yes	150	209	59	0.01
91	0.5	0.32	0.18	5.51	3.12	360	1.10	0.225	None	Yes	136	186	50	0.18

Notes:
1) Nozzle 89 coverage is limited 360 degrees for the axial extent listed as 0.075" and also limited by the funnel weld plug for the dimensions listed.
2) The angular coordinate for the OD UT was established visually by placing the transducer at the uphill side and declaring that position 180 degrees.
3) Position accuracy is estimated to be ± 20 degrees.
4) Nozzles 54, 85, and 89 were supplemented by PT examination on the nozzle OD to provide coverage of a band extending 0.5" below the weld toe.

Figure 1: Sketch of St, Lucie Unit 2 Nozzle Coverage Limitations Below the Weld Toe and Funnel Plug Weld